PATENT SPECIFICATION

702,188

Date of Application and filing Complete Specification: May 29, 1952.

No. 13666/52.

Application made in United States of America on March 5, 1952.

Complete Specification Published: Jan. 13, 1954.

Index at acceptance:—Classes 12(1), A6A1; 41, B1(B: V); 82(1), A2A, A4(C: E), A6A, A8(A1: B: K: R: V), A8Z(3: 12); and 82(2), F1A.

COMPLETE SPECIFICATION

Improvements in or relating to Plain Bearings

We, THE GLACIER METAL COMPANY LIMITED, of 368, Ealing Road, Alperton, Wembley, Middlesex, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to plain bearings. and is particularly concerned with improvements in steel-backed aluminium-lined bearings of the kind comprising electro-deposited overlay metals.

It is now recognised that engines which operate under various conditions of load, speed, corrosion, dirt and alignment require different bearing constructions in order to operate satisfactorily.

It has been common practice for many years to use steel-backed bearings lined with bearing metals for heavy duty bearing applications. These bearings, known as bearing inserts or thin-wall bearings, have the advantage of higher fatigue resistance than bearings made of solid bearing metal.

Thin-wall bearings are now being used which consist of aluminium bearing alloys bonded to a steel back. These aluminium bearing alloys will only function satisfactorily in a high load engine under conditions such that the shaft is hard and smooth, and has a sufficient running clearance with the bearing. Under less perfect conditions, the bearing will only run satisfactorily when provided with a suitable overlay. One method of making such steel-backed aluminium-lined bearings having an overlay of lead-base bearing alloy is as follows: A clean aluminium layer is bonded to a steel back in a known manner. The aluminium is provided with a layer of zinc by immersing it in a suitable zinc bath; a thin layer of copper is then deposited on the zinc layer from a copper strike solution, the copper layer having a thickness of 0.00002 to 0.00005" and then a layer of lead-base overlay alloy is electro-deposited on the thin copper layer. The process is known as the "zincate" process for electro-plating on aluminium.

Although electro-deposited lead-base alloys have been used to a considerable extent as overlay bearing metals, they have certain disadvantages. The major disadvantage of such lead-base alloys when used in an engine is that they corrode. This corrosion can be inhibited by the addition of tin to the lead-base alloys, but this leads to the formation in use of copper-tin compound caused by the reaction of the tin in the lead-base bearing alloy with the copper of the copper strike layer used for bonding the lead-base overlay layer to the aluminium bearing layer. The formation of the copper-tin compound, which is considered by many to be objectionable, can be inhibited by providing a barrier layer of nickel between the tin-containing lead-base alloy and the copper strike layer. However, the use of a nickel barrier layer is objectionable in that when the lead-base overlay layer has worn away, the nickel barrier layer is not of such character as to provide good bearing properties, nor is it of such character as to properly provide for embedding hard particles which may become detached from the shaft or which may consist of dirt or steel chips from machining operations, particularly when the engine is new.

In an attempt to improve the corrosion resistance of the bearings, tin-base overlay alloys have been used in place of lead-base overlay alloys, using the same method of bonding the tin-base alloy to the aluminium layer as had been used in bonding the lead-base alloy to the aluminium layer, i.e. by using the "zincate"

[P. Price

process which involves providing a copper strike layer having a thickness of 0.00002"—0.00005" between the aluminium layer and the tin-base alloy overlay layer. It has been found, however, that difficulties resulted after bonding tin-base alloys to aluminium by this process which were not encountered in bonding lead-base alloys to aluminium. At high operating temperatures, the tin of the overlay alloy combines with the thin copper bonding layer to form copper-tin compound which deteriorates in time so that the bond to the aluminium layer does not have sufficient life.

The present invention has for its object to provide an improved bearing of the kind referred to whereby adequate bonding of the overlay metal can be maintained even under high operating temperatures.

According to the present invention, a bearing comprises a steel back, a layer of aluminium-base bearing alloy bonded to the steel back, a layer of electro-deposited copper having a thickness of 0.0001" to 0.0005", bonded to the aluminium alloy bearing layer, and a layer of electro-deposited tin-base bearing material having a thickness of 0.0002" to 0.002" bonded to the copper layer.

It has been found that by providing a copper layer which is relatively thick as compared with the usual copper strike layer, effective bonding may be maintained even under high engine temperatures.

The bonding layer of copper should be at least 0.0001" thick, and preferably at least 0.0002" thick. Heavier copper layers up to 0.0005" thick may be used where desired. Tests have shown that a steel-backed aluminium-lined bearing with a 0.0002" thick layer of copper, and a 0.0005" overlay of tin, has a hot bond life of 200—400 hours at 150° C. Thinner tin layers give even a longer hot bond life. Also, at lower bearing temperatures, the bond life is longer.

The invention is hereinafter described, by way of example, with reference to the accompanying diagrammatic drawing, in which:—

Fig. 1 is a diagrammatic cross-section through a strip of bearing material which can be formed later into a bearing according to the invention; and

Fig. 2 is a view similar to Fig. 1 but illustrating the formation of a layer of copper-tin compound during use of the bearing at high temperature.

In carrying the invention into effect and with reference more particularly to Fig. 1 of the accompanying diagrammatic drawing, a bearing comprises a steel back 2, a layer 3 of aluminium bearing alloy bonded to the steel back, a layer 4 of electro-deposited copper bonded to the aluminium bearing alloy layer 3 which has been subjected to preliminary treatment in conventional manner, and a layer 5 of electro-deposited tin or tin-base bearing alloy bonded to the copper layer 4. The steel back may be S.A.E. 1010 steel, the back having a thickness of 0.10". The aluminium bearing alloy layer 3 may be an aluminium bearing alloy containing 6% tin, 1% copper, 1% nickel and 1% silicon, the balance being aluminium. The thickness of the layer 3 may be 0.020". The electro-deposited copper layer 4 may have a thickness between 0.0001" and 0.0005", and is preferably about 0.0002" thick. The layer 5 may have a thickness between 0.0002" and 0.002", and may consist of electro-deposited pure tin or electro-deposited tin alloy containing up to 15% of copper or up to 30% of antimony, or up to 20% of zinc, or any suitable combination of these alloying constituents, and up to 10% of any suitable hardening constituent, such as nickel, the tin content being not less than 70%.

The expression "tin-base bearing material" used herein includes either pure tin or the tin alloy above referred to.

When the improved bearing according to the invention is put into use, for example, in an engine, it will run well initially because of the excellent surface properties provided by the tin-base bearing material layer 5, assuming of course that usual bearing clearances are used and usual care is taken in assembly. Such a bearing is a precision bearing made to allow only for small dimensional tolerances on the precision parts, such precision parts consisting of the bearing, the shaft and the housing. Since these parts are precision made and since there are only slight allowances made in the tolerances, the bearing will not fit perfectly at first. In particular, the shaft will not seat perfectly into the bearing. When the engine is first started, it will bear on high areas on the surface of the tin layer 5. For a short time, these areas will be under a high load, but seizure will not take place because of the good surface properties of the tin. At the same time, the soft tin will wear away and be moved under the influence of the load until a much larger area is bearing the load. After the bearing has worn in and conformed due to some movement of the bearing as a whole, it will then function at high efficiency. After this has taken place, there will still be a tin layer present and this layer will have a rela-

tively long life. During this period in which the tin is present, there is little danger of seizure at low clearances because of the presence of the soft metal. Also, dirt such as commonly found in new engines is tolerated by a soft bearing surface better than by a harder metal. As the engine runs warm, a layer 6 of copper-tin compound (Fig. 2) will start to form between the tin layer 5 and the copper layer 4. As this copper-tin compound layer 6 thickens, its rate of formation will become slower, thus preventing excessive growth at engine temperatures. Eventually, the tin layer 5 will wear through. The copper-tin layer 6 will be exposed, but it will be broken up and embedded in the soft electro-deposited copper layer 4, and in the relatively soft aluminium bearing alloy layer 3. By this time, the bearing will have conformed to the shaft, and be well worn in and the shaft will be well seated. Also there will be greater clearances after the tin and copper layers have worn off, and under these conditions, the aluminium bearing alloy layer 3 will function satisfactorily.

It will be seen that a bearing made in accordance with the invention, in which the layer 5 is tin or tin-base alloy, will have a better resistance to corrosion than a bearing in which the overlay layer is lead or lead-base alloy. Furthermore, the improved bearing does not require the presence of a nickel barrier layer, which is objectionable in that it does not have as good bearing properties as the layer 4 of electro-deposited copper, nor does it have the ability to embed hard particles which the electro-deposited copper layer has. In the improved bearing, the provision of the different layers ensures that it will operate satisfactorily throughout a long life during which its various bearing layers are being worn away.

It will be understood that the invention is not limited to the particular embodiment hereinbefore described.

What we claim is:—

1. A bearing comprising a steel back, a layer of aluminium base bearing alloy bonded to the steel back, a layer of electro-deposited copper having a thickness of 0.0001″—0.0005″ bonded to the aluminium alloy bearing layer, and a layer of electro-deposited tin-base bearing material having a thickness of 0.0002″—0.002″ bonded to the copper layer.

2. The improved steel-backed aluminium-lined bearing, substantially as hereinbefore described with reference to the accompanying diagrammatic drawing.

URQUHART-DYKES & LORD,
Chartered Patent Agents,
Maxwell House, 11, Arundel Street,
Strand, London, W.C.2, and
12, South Parade, Leeds 1, Yorks.

Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.—1954.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

702,188 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

Fig.1.

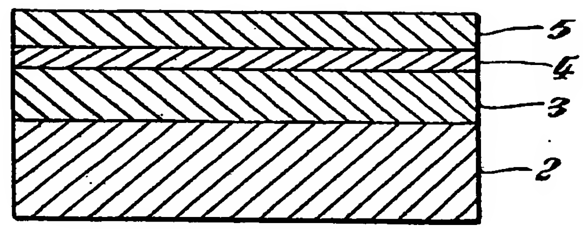

Fig.2.